Tritech International Limited

Please read this manual carefully before setting-up and using your unit

SeaStripe
Laser Line Projector (MKIII)

Operator & Installation Manual

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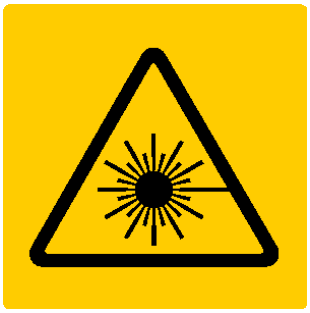

Note this manual contains important safety information which must be read prior to use of the product

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Handling of Electrostatic-Sensitive Devices

ATTENTION

Observe Precautions For Handling Electrostatic Sensitive Devices

Caution: Certain semiconductor devices used in the equipment are liable to damage due to static voltages.

Observe the following precautions when handling these devices in their unterminated state, or sub-units containing these devices:

- Persons removing sub-units from any equipment using electrostatic sensitive devices must be earthed by a wrist strap via a 1MΩ resistor to a suitable discharge reference point within the equipment.
- Soldering irons used during any repairs must be low voltage types with earthed tips and isolated from the Mains voltage by a double insulated transformer. Care should be taken soldering any point that may have a charge stored.
- Outer clothing worn must be unable to generate static charges.
- Printed Circuit Boards (PCBs) fitted with electrostatic sensitive devices must be stored and transported in appropriate anti-static bags/containers.

F110.1

WARRANTY STATEMENT

Tritech International Limited herein after referred to as **TIL**

TIL warrants that at the time of shipment all products shall be free from defects in material and workmanship and suitable for the purpose specified in the product literature.

The unit/system warranty commences immediately from the date of customer acceptance and runs for a period of 365 days. Customer acceptance will always be deemed to have occurred within 72 hours of delivery.

Note: Any customer acceptance testing (if applicable) must be performed at either TIL premises or at one of their approved distributors unless mutually agreed in writing prior to despatch.

Conditions:

These include, but are not limited to, the following:

1 The warranty is only deemed to be valid if the equipment was sold through TIL or one of its approved distributors.

2 The equipment must have been installed and commissioned in strict accordance with approved technical standards and specifications and for the purpose that the system was designed.

3 The warranty is not transferable, except or as applies to Purchaser first then to client.

4 TIL must be notified immediately (in writing) of any suspected defect and if advised by TIL, the equipment subject to the defect shall be returned by the customer to TIL, via a suitable mode of transportation and shall be freight paid.

5 The warranty does not apply to defects that have been caused by failure to follow the recommended installation or maintenance procedures. Or defects resulting from normal wear & tear, incorrect operation, fire, water ingress, lightning damage or fluctuations in vehicles supply voltages, or from any other circumstances that may arise after delivery that is outwith the control of TIL.
(**Note:** The warranty does not apply in the event where a defect has been caused by isolation incompatibilities.)

6 The warranty does not cover the transportation of personnel and per diem allowances relating to any repair or replacement.

7 The warranty does not cover any direct, indirect, punitive, special consequential damages or any damages whatsoever arising out of or connected with misuse of this product.

8 Any equipment or parts returned under warranty provisions will be returned to the customer freight prepaid by TIL

9 The warranty shall become invalid if the customer attempts to repair or modify the equipment without appropriate written authority being first received from TIL.

10 TIL retains the sole right to accept or reject any warranty claim.

11 Each product is carefully examined and checked before it is shipped. It should therefore be visually and operationally checked as soon as it is received. If it is damaged in anyway, a claim should be filed with the courier and TIL notified of the damage.

Note: TIL reserve the right to change specifications at any time without notice and without any obligation to incorporate new features in instruments previously sold.

Note: If the instrument is not covered by warranty, or if it is determined that the fault is caused by misuse, repair will be billed to the customer, and an estimate submitted for customer approval before the commencement of repairs.

F167.1

Waste Electrical and Electronic Equipment Directive (2002/96/EC - WEEE)

Tritech International Limited is very aware of its responsibilities to the environment and to the sustainability of the resources of our planet. The European Commission has issued the above Directive in an effort to reduce the impact on the environment due to electronic appliances being committed to landfill after they have come to the end of their useful life.

When the appliance referred to in this manual is no longer serviceable, it MUST NOT be discarded by placing in landfill, dumping in the sea or incineration. SEPARATE collection is mandatory.

The owner of the appliance should either return it and its associated leads & accessories, if appropriate, to Tritech International Limited with a certificate of decontamination (we reserve the right to protect our staff from the effects of any contamination) or sent to an appropriate treatment or recycling agency.

Any goods manufactured after 13th August 2005 that fall within the scope of the WEEE Directive are marked as shown opposite and will have the manufacturer's identification marks and optionally,the date of manufacture.	

SAFETY STATEMENTS & CE MARKING

The installation of the SeaStripe laser is fully the responsibility of the user. It is powered by a CLASS 3B green laser which is NOT inherently eye safe. Full consideration has been given to the requirements for CE marking and the relevant safety information is contained within this manual. Since the unit is supplied as a subsystem for use on an underwater vehicle, its safe use is installation specific; actual compliance is the responsibility of the installer. It must be operated in accordance with the following instruction manual. Failure to follow the recommendations of this manual may lead to safety hazards or equipment failure.

NOTE	***Throughout the manual certain potential problems, or further information relating to the installation, maintenance, understanding or use of the apparatus will be highlighted to the operator by indications identified by the adjacent symbol and text.***
CAUTION!	***Throughout the manual certain safety or operational related comments and requirements will be highlighted to the operator by indications identified by the adjacent symbol and text.***
DANGER!	***Throughout the manual certain safety or operational related comments and requirements that could lead to injury or loss of life will be highlighted by the adjacent symbol and text.***

Technical Support

Contact your local agent or Tritech International Ltd

	Mail	***Tritech International Ltd.*** Peregrine Road, Westhill Business Park, Westhill, Aberdeen, AB32 6JL, UK
	Telephone	++44 (0)1224 744111
	Fax	++44 (0)1224 741771
	Email	support@tritech.co.uk
	Web	www.tritech.co.uk

An out-of-hours emergency number is available by calling the above telephone number

If you have cause to use our Technical Support service, please ensure that you have the following details at hand **prior** to calling:

- System Serial Number (if applicable)
- Fault Description
- Any remedial action implemented

Due to the expansion of equipment capabilities and the fact that new sub-modules are continually being introduced, this manual cannot detail every aspect of the operation.

SECTION 1 SAFETY

Lasers, irrespective of classification, should ***always*** be treated as though they have the potential to damage eyesight.

DANGER!	**Laser beams** are generally not very divergent and so **can pose a risk even at great distances** from the source. **Damage to eyesight does not necessarily cause pain.**

The operator has to make sure that the manual has been fully understood and ensure that a risk analysis and appropriate precautions and procedures have been taken to ensure safe operation of the equipment.
The operating instructions must always be available where the equipment is used, and a place designated for keeping them. If a fault develops the equipment must be switched off immediately.

NEVER USE MAGNIFYING OPTICS TO VIEW THE LASER BEAM.

1.1 LASER HANDLING SAFETY PRECAUTIONS

DANGER!	***The SeaStripe Laser Line Projector contains a 20mW CLASS 3B laser. It should not be used in a dismantled condition, or with the protective cowl removed, or if damaged in any way. As packaged with the cowl in place and in an undamaged condition the risk of exposure is reduced to CLASS 3R. All mandatory precautions and procedures relevant to that class of laser must be followed. Before operating in air, the port should always be dried off.***

DANGER!	***The SeaStripe Laser Line Projector is only to be used by personnel qualified and authorised to handle laser devices.***

DANGER!	***The operator is to instruct every person who uses the device or who is working near the laser on the dangers of laser beams and on the responsible use of lasers. It is recommended that this instruction be repeated at least once a year.***

DANGER!	***When using the laser in the subsea environment care must be taken not to expose any personnel or any sensitive equipment to the laser beam. It must NOT be used in the vicinity of divers.*** ***NEVER point the laser at aircraft or other vehicles!***

DANGER!	***When lasers are in use the danger is not always obvious. For reasons of safety the people who are working with or nearby a laser have to be informed about the dangers of laser beams.***

DANGER!	***The working area in which the laser is installed must be marked as required by law, to prevent accidental injury to third parties.***

DANGER!	***It is prohibited to place a mirror or other optical device in the path of the laser beam – this can cause dangerous reflections.***

DANGER!	***A yellow warning label attached to the device denotes the class of laser. Never remove this label! It denotes the safety class and hence the measures that have to be observed when handling and using the laser.***

DANGER!	***Never level or aim the laser beam intentionally at people.***

When working with lasers, personnel should have access to safety eyewear which is certified to either EN207 or EN208 for the relevant wavelength(s) and power.

Familiarity with the following regulations will help protect you against avoidable injury:

EN 60825-1 Safety of Laser Products (German Equivalent is VDE 0837)
EN 207 Eye Protection
EN 208 Eye Protection for Laser Alignment
Health And Safety At Work Act 1974
ANSI Z136.1 (Standard for the safe use of lasers)
IEC 825-1 (Safety of laser products – Part 1: Equipment classification, requirements and users guide)

PD IEC TR 60825-14: 2004: Users guide

1.2 LASER CATEGORIES

(Reference information - take particular note of CLASSES 3R and 3B which are particularly relevant to the SeaStripe laser)

CLASS 1
This class is eye-safe under all operating conditions.

CLASS 1M
This class is safe for viewing directly with the naked eye, but may be hazardous to view with the aid of optical instruments. In general, the use of magnifying glasses increases the hazard from a widely-diverging beam (eg LEDs and bare laser diodes), and binoculars or telescopes increase the hazard from a wide, collimated beam (such as those used in open-beam telecommunications systems).
Radiation in classes 1 and 1M can be visible, invisible or both.

CLASS 2
These are visible lasers. This class is safe for accidental viewing under all operating conditions. However, it may not be safe for a person who deliberately stares into the laser beam for longer than 0.25 s, by overcoming their natural aversion response to the very bright light.

CLASS 2M
These are visible lasers. This class is safe for accidental viewing with the naked eye, as long as the natural aversion response is not overcome as with CLASS 2, but may be hazardous (even for accidental viewing) when viewed with the aid of optical instruments, as with CLASS 1M.

Radiation in CLASSES 2 and 2M is visible, but can also contain an invisible element, subject to certain conditions.

CLASSES 1M and 2M broadly replace the old CLASS 3A under IEC and EN classification. Prior to the 2001 amendment there were also lasers which were CLASS 3B but were eye-safe when viewed without optical instruments. These lasers are CLASS 1M or 2M under the current classification system.

CLASS 3R
Radiation in this class is considered low risk, but potentially hazardous. The class limit for 3R is 5x the applicable class limit for CLASS 1 (for invisible radiation) or CLASS 2 (for visible radiation). Hence continuous wave (CW) visible lasers emitting between 1 and 5 mW are normally **CLASS 3R**.
Visible CLASS 3R is similar to CLASS IIIA in the US regulations.

CLASS 3B
Radiation in this class is very likely to be dangerous. The radiation can be a hazard to the eye or skin. However, viewing of the diffuse reflection is safe.

CLASS 4
This is the highest class of laser radiation. Radiation in this class is very dangerous, and viewing of the diffuse reflection may be dangerous. CLASS 4 laser beams are capable of setting fire to materials onto which they are projected.

1.3 WAVELENGTH

The Tritech SeaStripe Laser Line Projector is exclusively concerned with visible wavelengths (green), so that, in comparison with infrared lasers, a certain degree of protection is provided by the blink reflex and other defence mechanisms.

This may limit damage due to direct exposure in the event of looking directly into a laser beam.

1.4 OUTPUT POWER/POWER DENSITY

The optical output power/power density (power per unit area) is a key value in classifying the laser and its danger levels.

Laser power measurements are made using an aperture of 7mm which typically corresponds to the dilated pupil of the human eye.

1.5 RISK ASSESSMENT IS THE RESPONSIBILITY OF THE USER!

It is essential that the person(s) responsible for installation of laser equipment understand the potential hazards associated with using laser equipment and implement such precautions and procedures to ensure the safety of both those who will operate the equipment, and any other persons in the vicinity of the equipment.

The SeaStripe laser contains a **CLASS 3B** laser which will cause eye damage if any person is directly exposed to it. The packaged product with the line generating optic reduces the power density at a distance of 50mm from the front face of the unit to less than 5mW into an aperture of 7mm diameter.

The cowl on the front of the Seastripe laser prevents a person getting closer to the laser source. In this condition the maximum risk of exposure is **CLASS 3R**.

In view of this, precautions and procedures for normal operation must as a minimum take the **CLASS 3R** rating into account.

Points to be included in such analysis should include <u>but are not limited</u> to the following:-

- Ensure that only trained personnel fully conversant with the procedures and precautions that have been decided on are responsible for installing the equipment.
- Ensure that no untrained personnel operate the system once the laser equipment is installed.
- Restrict personnel in the area whenever the laser is in use. If there is risk of exposure, consider the use of protective goggles certified under EN207 or EN208.
- Permit only short duration testing in air when all unnecessary personnel are excluded from the area.
- Fit a dedicated and well annotated master switch to control the laser. (Consideration should be given to this being a key switch)

- Ensure there are no divers in the vicinity where the laser is to be used.
- Normally only switch the unit on when submerged by more than 5m.
- Ensure that mountings cannot fail so as to change the orientation of the laser (this may allow it to point in an unexpected direction)
- Ensure that there are no reflective surfaces that may encroach into the laser beam (be particularly careful with manipulators or equipment mounted on pan and tilt units)

It is also necessary to include risk analysis for failure conditions:-

- The worst case single failure mode for the internal control electronics could momentarily raise output power by 25% to 25mW. That raises the power density at the distance of the cowl (edges where the line is brighter) to 3.9mW into a 7mm diameter.
- If a change occurs to the laser beam such as uneven line brightness or distorted geometry, then the unit should be treated as reverting to **CLASS 3B** and should not be used.
- If the cowl is broken then the unit should be treated as a **CLASS 3B** device in as far as it is possible to access an area of high power density close to the unit.

Under these conditions, the unit should be immediately taken out of service.

SECTION 2 SYSTEM DESCRIPTION

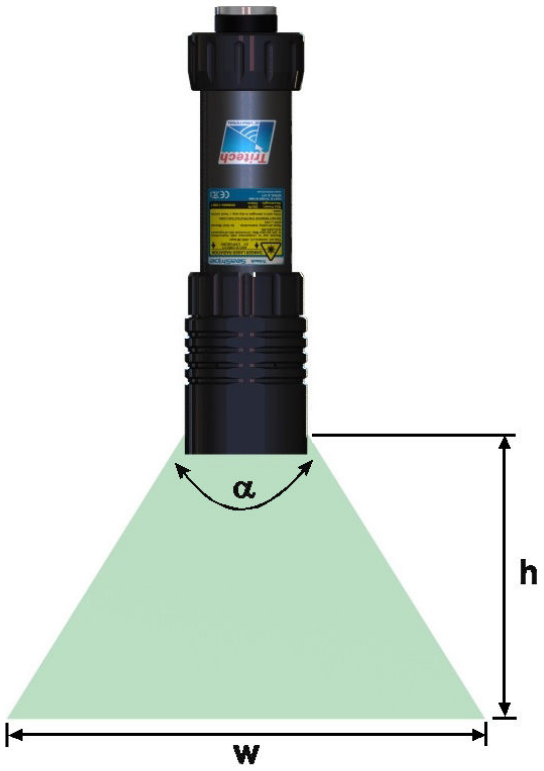
2.1 INTRODUCTION

The Tritech SeaStripe Laser Line Projector has been designed to operate in the subsea environment and is able to project a laser line up to 5m onto the surface under observation (highly dependant on water conditions).

It uses a **CLASS 3B** laser to project a “green” line shaped laser beam (64° beamwidth) onto the surface, this light can be used as an optical indicator. It uses a diode pumped solid state laser and has been designed for projection onto a variety of surfaces.

It has its own internal integrated power supply unit and can operate with a wide power input of 11 to 28 VDC

If mounted vertically onto the vehicle the length of the projection is proportional to the height of the laser above the surface (measured from approximately 80mm behind the laser port); figure 2 demonstrates this principle of operation for water operation.



α = 64 degrees approximately
WIDTH (**w**) = 1.25 x HEIGHT (**h**)

Figure 2

SECTION 3 SPECIFICATION

3.1 TECHNICAL DATA

Operating Life **	Approx 5,000 hrs
Wavelength	532nm
Laser Power	20mW **CLASS 3B**
Working Temp Range	4°C to +30°C
Storage Temperature	-40°C to +80°C
Spread of Beam	64° fan
Projection Distance in water##	Up to 5m
Installation Position	Any
Power Requirement	3.75W max (2.8W typ)
Input Voltages	11 to 28v DC
Depth Rating	4000 msw
Weight (in air) (in water)	1.7 kg 0.90 kg
Connector†	Tritech S0987 6 pin Pin 3 +VDC Pin 4 0VDC

** **This can be significantly reduced at increased operating temperatures e.g. in air operation.**

† Pin 5 of the connector can be used to modulate the beam digitally. Applying a maximum of 5v (2.0v threshold) DC with respect to 0v will switch the beam off. Input R is 10kΩ approximately.

Depends on water solids content, turbidity and ambient lighting.

3.2 MECHANICAL DATA

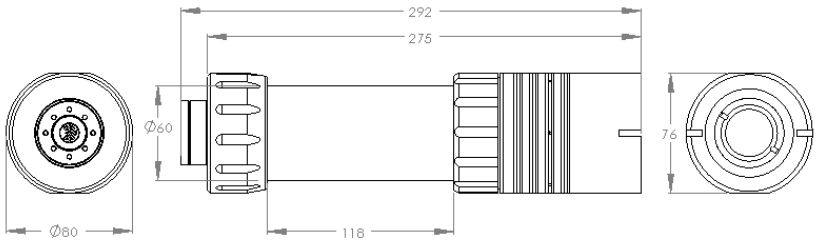


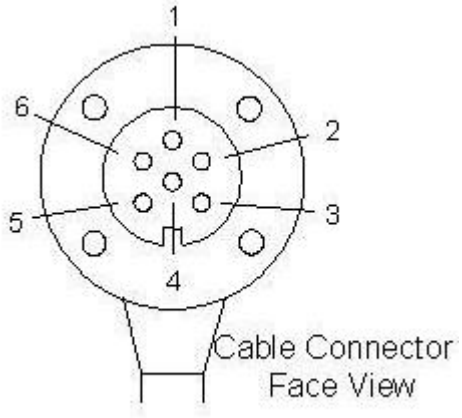
Figure 4 (Physical Dimensions)

Tritech International Limited
WWW.TRITECH.CO.UK
SeaStripe
DANGER LASER RADIATION
AVOID DIRECT EYE EXPOSURE
CLASS 3R LASER PRODUCT
This unit contains a CLASS-3B laser.
Normal use in conjunction with instructions within the User Manual restricts risk of exposure to CLASS-3R.
Read all safety instructions in the User Manual prior to use.
DO NOT REMOVE THE PROTECTIVE COWL.
If the unit is damaged in any way, it must not be used.
Max Power: 20mW
Wavelength: 532nm
EN 60825-1:2007
PART #: TI-1001-03-000
SERIAL #: 030
DEPTH RATING: 4000m

Typical Body Label

3.2 MECHANICAL DATA & PARTS LIST

3.3 ELECTRICAL PLUG (FEMALE) CONNECTION



1	**0vDC**	**Yellow**
2	**No Connection**	**Blue**
3	**+24v DC**	**Red**
4	**0v DC**	**Black**
5	**TTL Modulation**	**Green**
6	**Chassis**	**Screen**

DANGER!	***Do not allow the modulation input to be used as a separate on/off control for the laser. Operation with modulation must take into account the unexpected turning on of the laser beam when personnel are present and the possibility of a failure in the modulation control circuit.***

Tritech Right Angled Connector

Tritech Straight Connector

It is imperative that the o-ring and mating surfaces are checked for cleanliness and lightly greased before installation. All four screws are required to be properly tightened.

The right angled connector can be selected to be in any one of four exit positions.
This can be set at the factory on request.

SECTION 4 INSTALLATION

4.1 INSPECTION FOR TRANSPORT DAMAGE

Before using the laser for the first time, please check the following points:

a. Check that the transit case is undamaged (retain transit case in the event of return to Tritech).
b. Check that the laser and the subsea housing show no sign of damage.
c. In the event of damage to the package, or defects on the product supplied, notify the carrier and Tritech within 24 hours by telephone and followed up in writing within 7 working days.
d. Transport the laser only in its original packing.

DANGER!	***If the optics have been moved, maladjusted or refracted, the laser has to be classified as a CLASS 3B laser. In this case, all the safety regulations for lasers CLASS 3B have to be respected and it is recommended that the laser is removed from service and returned to Tritech for repair.***

4.2 CONFIGURATION

Before switching the laser on, complete the safety review, complete the risk analysis and preparation of required operational procedures and precautions.

CAUTION!	***Ensure that the supply voltage agrees with the required voltage range given in the technical specification.***

Ensure that the subsea housing pod retaining rings are secure.

Decide where the laser is to be mounted, if possible use a mounting bracket that is configurable in 3 axes. This will allow quick and easy adjustments to be carried out during the commissioning stage.

Assemble the laser on the vehicle, avoid using temporary fixing solutions. Long term accurate results depend upon a proper and stable method of attachment to the vehicle.
Check that the connector supplied has been correctly fitted. It employs an o-ring which must be in good order, clean and free of contaminants. The connector must be screwed down using the 4 screws supplied such that the o-ring is compressed.

CAUTION!	***The power supply must be free of 'spikes'. If voltage is expected to fluctuate greater than ± 10% then measures need to be taken to provide a stable voltage supply. The working voltage is not to exceed the limits stated in the specification. Operating voltages outside the range can damage the operation of the laser.***

DANGER!	***Before switching the laser on ensure that all necessary safety measures have been taken.***

It would be best if the laser beam was arranged to be directed onto a matt black or similar surface, safety glasses worn and the minimum number of personnel present.
Check that the power supply is of the correct polarity and voltage range. Connect the power supply and switch on. The unit will draw approximately 90mA from a 24v supply at room temperature and slightly more if colder.

DANGER!	***This version of the Sea Stripe has no warm up time. NEVER LOOK INTO THE LASER APERTURE OR BEAM PATH WHETHER THE BEAM IS PRESENT OR NOT.***

Ensure the laser is operating correctly and beam is present, if any faults are present, switch off and refer to the fault diagnosis section at the rear of the manual.

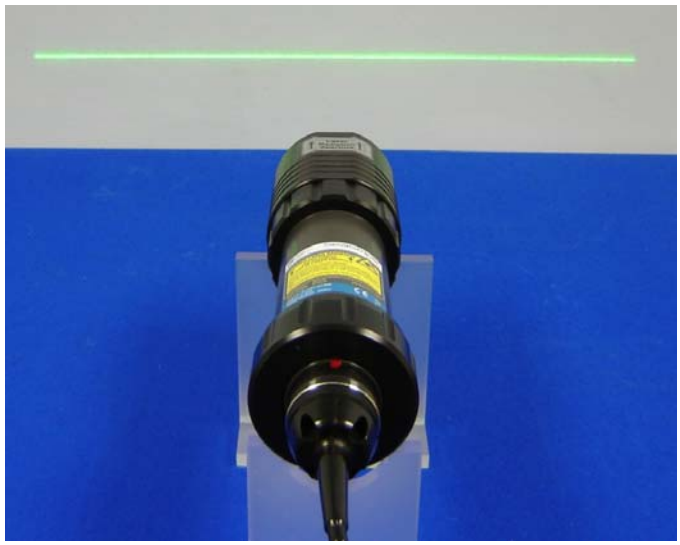


Figure 6
Figure 6 is an example of the laser line projector operating in air. The aperture is restricted to about 66 degrees in air.

CAUTION!	***Operating the laser in a high operating temperature (>25°C) will significantly reduce the lifetime of the device.***

4.3 LASER MOUNTING

Apart from the laser itself the most important component is the mounting. The design of the mounting must allow for quick and accurate calibration to be carried out thus ensuring the accuracy of the system.
Be aware that slight movement of the device at the installation site can produce larger deflections of the beam at longer ranges.

CAUTION!	***The Tritech Laser Line Projector is protected against vibration, however it is recommended that a 3-5mm thick damping element is fitted between the mount and the laser if any strongly vibrating machinery is in close proximity.***

SECTION 5 OPERATION

5.1 OPERATION OF EQUIPMENT

DANGER!	***Before switching the laser on, ensure that all necessary safety measures have been taken.***

The operating organisation must appoint and oversee those responsible for assembly, installation and operation of the equipment.

Operations that may negatively influence the safety of the equipment must be avoided.

Regulations that govern laser operation must be fully observed.

Changes to the equipment may NOT be made since this could affect the safety classification of the laser.

The Tritech Laser Line Projector is suitable for intermittent operation and for 24-hour continuous duty.

5.2 OPTICS

DANGER!	***The laser optics must not be adjusted or removed from their housing.***

DANGER!	***Any changes to the operation of the laser and its surrounding environment that affect the optical characteristics of the laser must have a risk assessment carried out before further operations are carried out.***

SECTION 6 MAINTENANCE

DANGER!	***If, for any reason, the laser housing pod view port protective shield is damaged or altered or the laser is dismantled then it must be treated as CLASS 3B. All the relevant safety precautions must be observed in accordance with the current issue of EN 60825-1.***

6.1 ROUTINE MAINTENANCE

The Tritech Laser Line Projector is essentially maintenance free; all that is necessary is to clean the pod-housing view port and laser lens optic (with a fine water jet and then wipe with a suitably soft cloth) at regular intervals but it is advisable to wash down the device with fresh water after each dive.

DANGER!	***When cleaning the laser pod housing view port and laser lens optic ensure that power has been removed. Avoid looking directly into the laser and if practical clean the lens by approaching from the side or the rear.***

6.2 REPAIR

Never try and repair the laser yourself, if repair is necessary, return the laser to Tritech.

6.3 FAULT DIAGNOSIS

DANGER!	**Observe all safety precautions at the start of the chapter. There are no user serviceable parts inside the unit and opening the unit will invalidate the warranty.**

Fault	Possible Cause	Action
Laser beam distorted or out of focus	The laser housing pod view port is dirty or has air bubbles in front of it or if viewed in air, can have water droplets on the port	Remove power and clean the view port with a non solvent cleaner.
Laser is noisy in operation, laser light "flickers".	Unstable or defective power supply. Poor connections.	Check power supply and connections. If all power supplies are stable and within limits, return to Tritech for repair.
Change of Line Geometry or Uneven Brightness	Optic badly adjusted or defective	Return to Tritech for repair
Laser Beam Split	Laser diode damaged by unstable power supply or ESD.	Return to Tritech for repair
No laser beam visible **DO NOT LOOK DIRECTLY INTO BEAM PATH WHETHER OR NOT A BEAM IS PRESENT!**	Unstable power supply	1. Check power cable is connected and not loose. 2. Check input power supply to laser. 3. If the internal supply overload protection has tripped out, allow to cool and switch the unit back on. 4. If the unit is still not operating return to Tritech for repair.